



## White Paper

# Global Hunger Index does not really measure hunger - An Indian perspective

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Received July 4, 2021

**The Global Hunger Index (GHI) is calculated and disseminated annually. India, which is the 5<sup>th</sup> largest economy in the world and has a good ranking in many other indicators, has a poor ranking based on this index. After a critical review of the appropriateness of the indicators used in GHI, the Indian Council of Medical Research has the viewpoint that the indicators of undernourishment, stunting, wasting and child mortality do not measure hunger *per se*. Referring to this index as a Hunger Index, and thereby ranking countries is not appropriate, since many of the measures that are used to evolve an index that measures hunger are probably contextual. Countries should therefore evolve their own measures that are suitable for their own context.**

**Key words** Child mortality - GHI - hunger - nutrition - stunting - undernourishment - wasting

The Global Hunger Index (GHI) was initially developed to focus attention and mobilize political will in the fight against hunger<sup>1</sup>. The GHI has subsequently been used as a metric to annually measure and track hunger at the global, regional and national levels, since 2006<sup>2</sup>. India has ranked poorly in the GHI: in 2017<sup>3</sup>, India ranked 100<sup>th</sup> among 119 countries and in 2019<sup>1</sup>, India's rank had slipped to 102. In 2020

India ranked at 94<sup>th</sup> position out of 107 countries<sup>4</sup>. This ranking was counterintuitive, considering that India ranks fifth in the world economy<sup>5</sup>. Hunger is an emotional subject and there have been many criticisms and rebuttals of the GHI. Indian policymakers have argued that the GHI is a misleading hunger index as its methodology ignores genetic factors<sup>6</sup> wherein international norms on stunting and wasting may not

be applicable to India<sup>7,8</sup>. Noted columnists in India have also commented on how a faulty metric, which is based on four measures or indicators (none of which actually measure hunger) is creating a flawed narrative against India<sup>9,10</sup>. Prominent researchers have commented that the GHI exaggerates the measure of hunger, lacks statistical vigour<sup>10</sup>, has a problem of multiple counts<sup>11,12</sup>, and gives higher representation to under-five children. The measurement of hunger is complex and should not be oversimplified, as in the GHI<sup>13</sup>. Therefore, the use of alternative approaches should be considered to evaluate hunger<sup>14,15</sup>. In view of these issues, the Indian Council of Medical Research (ICMR), Department of Health Research of the Ministry of Health and Family Welfare, Government of India, constituted in 2019 an Expert Committee to review the indicators used in the GHI. The deliberations of this Committee are presented here, and it is argued that the four indicators used in the GHI, [undernourishment, stunting, wasting and child mortality (CM)] do not measure hunger *per se*, as these are not the manifestations of hunger alone.

### About the GHI

The GHI is a weighted average derived from four indicators<sup>1</sup>. These are (i) the PUN, or proportion of the population that is undernourished, calculated as the proportion of the population that has an energy intake less than the FAO Minimum Dietary Energy Requirement (MDER) of 1800 calories/capita/day<sup>1</sup>; (ii) CWA, or the prevalence of wasting in children under five years old, estimated as the percentage of children aged 0-59 months, whose weight for height is below minus two standard deviations (-2SD) from the median of the WHO Child Growth Standards<sup>1</sup>; (iii) CST, or the prevalence of stunting in children under five years old, estimated as the percentage of children, aged 0-59 months, whose height for age is below -2SD from the median of the WHO Child Growth Standards; and (iv) CM, or the proportion of children dying before the age of five, estimated as the proportion of child deaths between birth and five years of age, generally expressed per 1000 live births. As per the justification mentioned in the GHI report<sup>1</sup> for using these indicators, the PUN indicator captures the nutrition situation of the entire population while the other indicators are specific to under-five children (CWA, CST and CM) in which the adverse effects assume greater importance. The inclusion of both wasting and stunting (CWA and CST) is intended to allow the GHI to consider both acute and chronic undernutrition.

**Table I.** Proportion of stunted and wasted children among mothers with normal and higher body mass index

BMI category	Stunting (%)	Wasting (%)
Normal BMI (18.5-24.9 kg/m <sup>2</sup> )	38.2	20.4
Overweight BMI (>25 kg/m <sup>2</sup> )	27.1	14.2

Source: Ref 17. BMI, body mass index; NFHS, National Family Health Survey

### Is hunger manifested in undernourishment, stunting, wasting and child mortality?

It is of interest to examine whether the indicators used in the GHI actually measure hunger. If these are manifestations and consequences of hunger, the simple corollary is that among those who are relatively rich, having sufficient purchasing power and with no problem of access to food, the proportion of undernourished, stunting, wasting and CM should be negligible. To examine the corollary stated above, the findings from National Sample Survey Office (NSSO)<sup>16</sup> and National Family Health Survey, 2015-16 (NFHS-4)<sup>17</sup> are important and relevant. The data collected by these surveys provide estimates of the GHI parameters for different wealth quantiles. To calculate wealth for each household, a score is calculated using information on household characteristics, amenities and assets. The households are then ranked and categorized into five (1<sup>st</sup> to 5<sup>th</sup>) wealth quantiles which are lowest, second, middle, fourth and highest, respectively. It is evident that the top two wealth quantiles, the fourth and highest, which represent the top 40 per cent of the population, could be considered to be those who would have sufficient purchasing power and access to food to meet all their nutrition requirements. The measured proportions of undernourishment, stunted and wasted children in these two wealth quantiles (4<sup>th</sup> and 5<sup>th</sup>) were 7.3, 25.7 and 18.6 per cent, respectively, while the under-five mortality per 1000 live births was 25.8<sup>16,17</sup>. This indicates that undernourishment, stunting, wasting and CM are not the consequences of hunger alone, as these manifestations are seen among the relatively rich as well. Further, in the NFHS-4 data (Table I), stunting (27.1-38.2%) and wasting (14.2-20.4%) were significantly prevalent among children of normal body mass index (BMI, 18.5-24.9 kg/m<sup>2</sup>) and overweight mothers (BMI >25 kg/m<sup>2</sup>). Presumably, these mothers, with normal and higher BMI, should have no problem of shortage of food for their children, and as a corollary, the levels of stunting and wasting should have been negligible. Thus, these results reject the notion that the indicators of undernourishment, stunting, wasting and

**Table II.** Prevalence (%) of overweight and obesity among those consuming <1800 calories per capita per day

BMI category	Urban (%)		Rural (%)	
	Male	Female	Male	Female
BMI WHO classification <sup>20</sup>				
Overweight (25-29.9 kg/m <sup>2</sup> )	28.1	30.4	8.3	11.2
Obese (≥30 kg/m <sup>2</sup> )	5.7	15.9	0.9	2.5
BMI Asian classification <sup>21</sup>				
Overweight (23-27.49 kg/m <sup>2</sup> )	36.1	33.3	15.2	16.8
Obese (≥27.5 kg/m <sup>2</sup> )	16.6	28.5	3.1	6.2

*Source:* Ref 19. NNMB, National Nutrition Monitoring Bureau; BMI, body mass index

CM used in the GHI are the causes or the consequences of hunger. Therefore, it is not appropriate to consider the GHI as measuring hunger with accuracy. Additional inconsistencies with these indexes are given below.

(i) *Undernourishment*: The proportion of the population consuming less than the FAO MDER of 1800 kCal/capita/day is the PUN<sup>18</sup>. If this were so, there should not be any symptoms of overnutrition among these. As per the data from National Nutrition Monitoring Bureau (NNMB) survey<sup>19</sup>, a substantial proportion of the population, who consume less than MDER, is overweight (BMI >25 kg/m<sup>2</sup>; ~29% in urban and 10% in rural areas) and obese (BMI >30 kg/m<sup>2</sup>; ~10% in urban and 2% in rural areas) (Table II). This is counterintuitive, as these BMI proportions are consequences of over nutrition. Further, in the same NNMB survey, it appeared that a sizable proportion among those consuming less than MDER (1800 kCal/capita/day) also had raised levels of biochemical parameters that are commonly associated with overnutrition (Table III).

(ii) *Stunting (CST)*: the inclusion of stunting as an indicator in GHI has implicit assumption that those who are hungry are likely to be short-statured. This can be contested since child's height is dependent on both maternal and paternal stature<sup>22</sup>. The difference in height between individuals is not influenced by nutrition alone but by genetic, biological and environmental factors also<sup>23</sup>. Another view is about the impact of food supplementation interventions. Evidence indicates that the increase in the anthropometric indices by food-based interventions including those during pregnancy is only modest (by 0.1-0.25 SD or 5-10% deficit), with unsustainable benefits<sup>24</sup>. Other contributors to anthropometric indices are maternal characteristics, water, sanitation and hygiene, curative and

preventive healthcare, *etc.* In tandem with the overall national development, importantly, a gradual decline over time in the stunting of children is being observed and this trend has hastened in the past decade, even among the underprivileged<sup>24</sup>. Thus, it would not be correct to relate stunting in under-five children with hunger alone.

(iii) *Wasting (CWA)*: there are concerns about the use of thinness/wasting among children as a surrogate for quantifying hunger. From a different perspective, biomarkers of cardiometabolic health, such as the lipid profile and fasting blood glucose defined as per accepted international criteria<sup>25,26</sup>, which are also proximate reflectors of recent nutritional balance, have been examined. In studies conducted in Delhi, India<sup>27,28</sup>, among school children aged 5-18 yr, the relation of these biomarkers of cardiometabolic health to thinness (BMI-for-age below -2SD of the sex-specific WHO reference) showed that paradoxically, 11.0 per cent boys and 7.9 per cent girls with any cardiometabolic abnormality were thin. The corresponding figures for pre-hypertension were 13.7 and 8.1 per cent, respectively. For these situations, dietary restrictions, including reduced caloric intake, and lifestyle interventions are recommended. These findings indicate a substantial discordance between anthropometric measures of thinness and biomarkers, including the extreme scenario of overnutrition. This paradoxical finding was recently confirmed at a national scale from the recent quality-controlled Comprehensive National Nutrition Survey in a sample of 19143 participants<sup>29</sup>. This study showed that the intra-individual coexistence of 'metabolic obesity' in anthropometrically undernourished Indian children had worsened. The proportions of children with at least one abnormal biomarker of cardiometabolic health (note that here the definition of dysglycaemia was based on either HbA<sub>1c</sub> or

**Table III.** Prevalence (%) of raised biomarkers of adults consuming <1800 kcal per capita per day

Biomarkers	Urban (%)		Rural (%)	
	Male	Female	Male	Female
<b>HTN</b>				
SBP $\geq$ 140 mmHg and/or DBP $\geq$ 90 mmHg	33.1	22.5	22.2	20.3
<b>Total cholesterol</b>				
$\geq$ 200 mg/dl	23.3	22	NA	NA
<b>Low density lipoproteins</b>				
$\geq$ 130 mg/dl	24.2	26.3	NA	NA
<b>High density lipoproteins</b>				
Low (<40 mg/dl (men) and <50 mg/dl (women))	71.5	83.7	NA	NA
<b>Triglycerides</b>				
$\geq$ 150 mg/dl	39.2	28.2	NA	NA
<b>Blood sugar</b>				
$\geq$ 126 mg/dl	14.1	10.5	7.3	6

*Source:* Ref 19. HTN, hypertension; SBP, systolic blood pressure; DBP, diastolic blood pressure; NA, not available; NNMB, National Nutrition Monitoring Bureau

fasting blood glucose) were 56.2 per cent overall, 54.2 per cent in thin (BMI-for-age  $<-2$ SD) and 59.3 per cent in stunted (height-for-age  $<-2$ SD) participants. Although children 5-19 yr were studied, for practical purposes, there should be no problem in extrapolating these findings to under five children, particularly because the GHI aims to quantify hunger at the entire population level, and not the specific age group of 0-5 yr. Severe wasting also referred to as severe acute malnutrition (SAM), is considered to be a serious life-threatening acute condition. Children with uncomplicated SAM, or without infections, are believed to have high case-fatality (up to 10-20%)<sup>30</sup> unless they are fed energy-dense foods (like ready-to-use therapeutic foods, generally administered through a Community Management of Acute Malnutrition Programme). However, two studies from deprived settings of India (rural Meerut<sup>31</sup>, and rural/tribal Odisha and Jharkhand<sup>32</sup>) found low case-fatality rates (0.7-1.5% over two months) in such children, who were not provided with any extra therapeutic foods. This suggests that the role of food deprivation, or hunger, in the aetiology of severe wasting is overestimated.

(iv) *Under-5 mortality (CM)*: the inclusion of CM as an indicator under GHI has the underlying assumption that hunger is the major cause of CM. This is, however, not supported by the data on the cause of death for children under five years. According to UNICEF<sup>33</sup>, nearly 62 per cent of under-5 mortality occurs in the neonatal period. Major

causes of neonatal death are preterm birth (35%), sepsis (33%), birth asphyxia/intrapartum-related complications (20%) and congenital malformations (9%). Beyond the neonatal period, the leading causes of under-five mortality are diarrhoea (8%) and pneumonia (14%). Similar findings have been reported in the Million Death Study<sup>34,35</sup>. According to this, in India, pre-term birth complications resulted in 25.5 per cent deaths; intrapartum-related events 11.1 per cent; sepsis 7.9 per cent; congenital 6.0 per cent; pneumonia 6.0 per cent; tetanus 0.6 per cent; injuries 0.5 per cent; diarrhoea 0.4 per cent and others 3.0 per cent. There is no persuasive evidence from global randomized trials suggesting that these important causes of neonatal deaths could be addressed by food supplementation. Thus, the conceptual basis for using under-5 mortality as one of the indicators of GHI is questionable.

### Conclusion

Based on the available evidence as collated above, the indicators of undernourishment, stunting, wasting and CM do not measure hunger, and thus, referring to GHI as Hunger Index is a misnomer. While the Index intends to assess the status for the entire population, it actually gives excessive weightage to under-5 children. The calculation of GHI as an index in terms of percentage is often interpreted as the percentage of hunger by the general population. India is one of the few countries where indirect data on hunger had been collected till 2009-2010, through surveys that



asked a couple of questions relating to the intake of two square meals a day. These data, collected by the NSSO, have high acceptability at both national and international levels<sup>10,11</sup>. It is time to restart the collection of such data to capture information on hunger. It is important to mention here that the FAO has been propagating the Food Insecurity Experience Scale (FIES) as a measure of hunger, which has been experimented on and calculated by a large number of countries<sup>36</sup>. The measurement of hunger is a sensitive issue; therefore, due care is required in assessing the appropriateness of FIES as a measure for hunger in India, given the very nature of a perception-based survey like the FIES. Other measures of hunger such as Food and Nutrition Technical Assistance (FANTA) based Food Access Survey Tools (FAST) and its modified version (MFAST)<sup>11</sup> in the Indian context may also be considered. The measurement of hunger is a complex methodological issue and a challenge for statisticians and subject experts. In view of this, a robust and acceptable country-specific methodology needs to be developed to measure hunger on priority. Proxy indicators for hunger should be avoided. Zero hunger is one of the important goals of Sustainable Development Goals<sup>37</sup>, therefore, this initiative is not only essential but also requires a full stop to the use of indirect and ill-conceived measures of hunger like GHI. Importantly, for International comparison, there has to be a common measurement which could be developed through consensus among countries after they had developed their own measures.

**Financial support & sponsorship:** None.

**Conflicts of Interest:** None.

### References

1. von Grebmer K, Bernstein J, Patterson F, Wiemers M, Chéilleachair RN, Foley C, *et al*. 2019 *Global Hunger Index: The challenge of hunger and climate change*. Bonn: Welthungerhilfe; and Dublin; Concern Worldwide; 2019.
2. International Food Policy Research Institute. *A Global Hunger Index: Measurement concept, ranking of countries, and trends*. Food Consumption and Nutrition Division Discussion Paper 212. Washington, DC: IFPRI; 2006.
3. von Grebmer K, Bernstein J, Brown T, Prasai N, Yohannes Y, Towey O, *et al*. 2017 *Global Hunger Index; The inequalities of hunger*. Washington, DC, Dublin and Bonn: International Food Policy Research Institute, Welthungerhilfe and Concern Worldwide; 2017.
4. von Grebmer K, Bernstein J, Wiemers M, Acheampong K, Hanano A, Higgins B, *et al*. 2020 *Global Hunger Index; One decade to zero hunger linking health and sustainable food systems*. Bonn: Welthungerhilfe; and Dublin; Concern Worldwide; 2020.
5. International Monetary Fund. *International monetary fund data mapper*. Available from: <https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEOWORLD/IND>, accessed on March 9, 2020.
6. Panagariya A. Does India really suffer from worse child malnutrition than sub-Saharan Africa? *Econ Polit Wkly* 2013; 48 : 98-111.
7. The Hindu. *A misleading hunger index*. Available from: <https://www.thehindu.com/opinion/op-ed/a-misleading-hunger-index/article21255142.ece>, accessed on March 9, 2020.
8. The Indian Express. *Hungry for publicity*. Available from: <https://indianexpress.com/article/opinion/columns/hungry-for-publicity-ifpri-hunger-index-poverty-fake-news/>, accessed on July 3, 2021
9. OpIndia. *How a faulty metric to calculate global hunger is creating a flawed narrative against India*. Available from: <https://www.opindia.com/2017/10/how-a-faulty-metric-to-calculate-global-hunger-is-creating-a-flawed-narrative-against-india/>, accessed on July 2, 2021.
10. The Times of India. *5 ways to combat pessimism about the hunger index*. Available from: <https://timesofindia.indiatimes.com/blogs/Swaminomics/5-ways-to-combat-pessimism-about-the-hunger-index/>, accessed on July 2, 2021.
11. Nigam AK. Global Hunger Index Revisited. *J Indian Soc Agric Statistics* 2018; 72 : 225-30.
12. Masset E. A review of hunger indices and methods to monitor country commitment to fighting hunger. *Food Policy* 2011; 36 (Suppl 1) : S102-8.
13. Aiga H. Hunger measurement complexity: Is the global hunger index reliable? *Public Health* 2015; 129 : 1288-90.
14. Nigam AK. Improving global hunger index. *Agric Res* 2019; 8 : 132-9.
15. Nigam AK, Srivastava R, Tiwari PP, Saxena R, Shukla S. Hunger in *Gram Panchayats* of Banda district (U.P.): A micro-level study. *J Indian Soc Agric Statistics* 2016; 70 : 41-50.
16. National Sample Survey Office. *Nutritional Intake in India, 2011-12*. NSS 68<sup>th</sup> Round. New Delhi: National Statistical Organization. Ministry of Statistics and Programme Implementation: Government of India; 2014.
17. International Institute of Population Science. *National Family Health Survey India 2015-2016: India fact sheet*. Mumbai: MoHFW, Government of India; 2016.
18. FAO, IFAD, UNICEF, WFP and WHO. *The State of Food Security and Nutrition in the World 2019. Safeguarding against Economic Slowdowns and Downturns*. Rome: FAO 2019.
19. National Nutrition Monitoring Bureau. *Technical report No. 26. Diet and nutritional status of rural population, prevalence of hypertension & diabetes among adults and infant & young child feeding practices: Report of third repeat survey*. Hyderabad: NIN- Indian Council of Medical Research; 2012.
20. World Health Organization. *Obesity*. Available from: [https://www.who.int/health-topics/obesity#tab=tab\\_1](https://www.who.int/health-topics/obesity#tab=tab_1), accessed on September 21, 2021.

21. Misra A, Chowbey P, Makkar BM, Vikram NK, Wasir JS, Chadha D, *et al.* Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. *J Assoc Physicians India* 2009; 57 : 163-70.
22. Gupta A, Cleland J, Sekher TV. Effects of parental stature on child stunting in India. *J Biosoc Sci* 2021; 19 : 1-12.
23. Jelenkovic A, Sund R, Hur YM, Yokoyama Y, Hjelmborg JV, Möller S, Honda C, *et al.* Genetic and environmental influences on height from infancy to early adulthood: An individual-based pooled analysis of 45 twin cohorts. *Sci Rep* 2016; 6 : 28496.
24. Sachdev H. Undersized Indian children: Nutrients-starved or hungry for development? *Proc Indian Natn Sci Acad* 2018; 84 : 867-75.
25. National High Blood Pressure Education Program Working Group on high blood pressure in children and adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics* 2004; 114 : 555-76.
26. Zimmet P, Alberti G, Kaufman F, Tajima N, Silink M, Arslanian S, *et al.* The metabolic syndrome in children and adolescents. *Lancet* 2007; 369 : 2059-61.
27. Garg P, Kaur S, Gupta D, Osmond C, Lakshmy R, Sinha S, *et al.* Variability of thinness and its relation to cardiometabolic risk factors using four body mass index references in school children from Delhi, India. *Indian Pediatr* 2013; 50 : 1025-32.
28. Sachdev HS, Sinha S, Sareen N, Pandey RM, Kapil U. Survival and recovery in severely wasted under-five children without community management of acute malnutrition programme. *Indian Pediatr* 2017; 54 : 817-24.
29. Sachdev HS, Porwal A, Sarna A, Acharya R, Ramesh S, Kapil U, *et al.* Intraindividual double-burden of anthropometric undernutrition and “metabolic obesity” in Indian children: A paradox that needs action. *Eur J Clin Nutr* 2021; 75 : 1205-17.
30. World Health Organization. *Community-based management of severe acute malnutrition: a joint statement by the World Health Organization, the World Food Programme, the United Nations System Standing Committee on Nutrition and the United Nations Children’s Fund.* Geneva: WHO; 2007.
31. Kapil U, Pandey RM, Bansal R, Pant B, Varshney AM, Yadav CP, *et al.* Mid-upper arm circumference in detection of weight-for-height z score below -3 in children aged 6–59 months. *Public Health Nutr* 2018; 21 : 1794-99.
32. Prost A, Nair N, Copas A, Pradhan H, Saville N, Tripathy P, *et al.* Mortality and recovery following moderate and severe acute malnutrition in children aged 6-18 months in rural Jharkhand and Odisha, eastern India: A cohort study. *PLoS Med* 2019; 16 : e1002934.
33. United Nations Children’s Fund. *Neonatal Health.* Available from: <https://unicef.in/Whatwedo/2/Neonatal-Health->, accessed on January 7, 2020.
34. Million Death Study Collaborators. Changes in cause-specific neonatal and 1-59-month child mortality in India from 2000 to 2015: A nationally representative survey. *Lancet* 2017; 390 : 1972-80.
35. Liu L, Chu Y, Oza S, Hogan D, Perin J, Bassani DG, *et al.* National, regional, and state-level all-cause and cause-specific under-5 mortality in India in 2000-15: A systematic analysis with implications for the Sustainable Development Goals. *Lancet Glob Health* 2019; 7 : e721-34.
36. Food and Agricultural Organisation of the United Nations. *Measuring Hunger.* Available from: <https://www.fao.org/fao-stories/article/en/c/1201668/>, accessed on September 21, 2021.
37. United Nations. *Sustainable Development Goals.* Available from: <https://www.un.org/sustainabledevelopment/hunger/>, accessed on July 1, 2021.

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